Case Report - TMJ Surgery

Application of virtual three-dimensional surgery planning in management of open bite with idiopathic condylar resorption

Access this article online
Website: www.amsjournal.com
DOI: 10.4103/2231-0746.175760
Quick Response Code:

Chung How Kau, Morvarid Poorsattar Bejemir
Department of Orthodontics, University of Alabama at Birmingham, Birmingham, Alabama, USA

Address for correspondence:
Prof. Chung How Kau, Department of Orthodontics, University of Alabama at Birmingham, Birmingham, Alabama, USA.
E-mail: ckau@uab.edu

ABSTRACT

This case report describes the successful treatment of an adult patient with idiopathic condylar resorption and Class II skeletal open bite malocclusion and temporomandibular joint disorder. A segmental Le Fort I bilateral osteotomy, ramus increasing length inverted L–osteotomy, and genioplasty combined with orthodontic treatment were performed. The treatment plan and surgery was aided by three-dimensional medical modeling, and we managed to resolve functional, esthetic, and pain concerns to a satisfactory level.

Keywords: Condyle, idiopathic, modeling, open bite, resorption, three-dimensional

INTRODUCTION

Anterior open bite describes the relationship of the incisors where there is no vertical overlap of teeth. Number of factors may be involved and may be a result of skeletal, dental, or combination of both.[1] Formulation of such complex malocclusion requires meticulous observation and examination and treatment might include intricate orthodontic and surgical steps. With recent technologic advancement, the feasibility and accuracy of presurgical planning has been improved to a great extent with computer-aided simulation.[2] In this article, we present a patient with idiopathic condylar resorption (ICR) and skeletal Class II high-angle malocclusion and open bite who was treated orthodontically and surgically guided by preoperative three-dimensional (3D) simulation.

CASE REPORT

Diagnosis and etiology

A 22-year-old Caucasian female patient presented to the department with a chief complaint of "her anterior teeth not touching." Her past medical history was not significant, and she was not on any medication except for occasional pain killers for her temporomandibular joint (TMJ) pain.

On gross head and face physical examination, she had a convex high-angle facial profile and increased lower third. Her mandible was retrognathic (ANB: 73.7), and chin was also deficient. A significant facial asymmetry was noticed that affected both maxilla and mandible. Intraoral examination revealed an 8 mm anterior open bite with three-step occlusion planes. Overjet was increased to 11 mm and buccal segment had cross bite.

Cite this article as: Kau CH, Bejemir MP. Application of virtual three-dimensional surgery planning in management of open bite with idiopathic condylar resorption. Ann Maxillofac Surg 2015;5:249-54.

Maxilla was deficient in transverse dimension. The patient had full cusp Class II angle molar and canine relation. On smiling, the patient exhibited increased gingival show which was more remarkable on posterior in addition to occlusal cant. Both maxilla and mandibular incisors had space deficiency. Maximum mouth opening was within normal range [Figures 1 and 2].

Her lateral cephalometrics indicated a skeletal high-angle Class II malocclusion; the right condyle was heavily resorbed and both rami were short in length. A hyperdivergent pattern was noticed with a high mandibular plane angle (FMA: 41.3, SN- MP: 53.3) [Figures 3-5 and Table 1].

Her blood tests did not show any sign of inflammatory process or other metabolic or hormonal imbalance or indicated no autoimmune or other systemic cause for patient's condyle resorption. Based on physical examination, radiographs, and blood test results, a diagnosis of ICR was made.

Possible treatment alternatives were discussed with the patient, and a comprehensive orthodontic–orthognathic surgery treatment plan was selected. The best option was discussed with a 3D medical modeling with the surgeon. It included pre- and post-surgical orthodontic treatment objectives to achieve maximum interception and macro- and mini-esthetics.

Figure 1: Pretreatment photographs

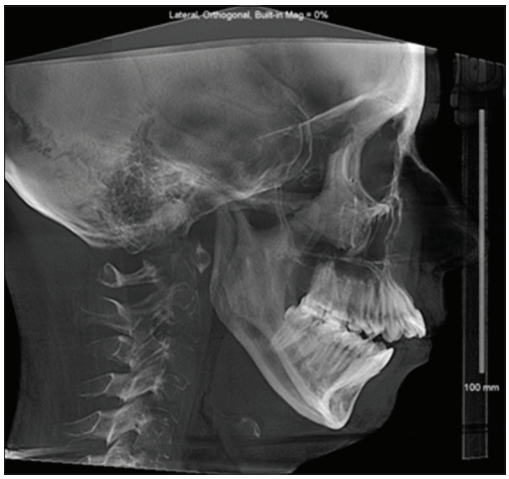

Figure 3: Pretreatment radiograph

Treatment objectives

Treatment objectives included correction of anteroposterior, transverse, and vertical discrepancies of both maxilla and mandible with regards to each other and to improve esthetics and also reduce TMJ discomfort.

Treatment plan

Her treatment plans were as follows:

- Oral hygiene instruction, caries control, and periodontal maintenance
- Presurgical orthodontics including upper and lower preadjusted appliance prescription, maintenance of lower arch transverse dimension, and to align maxillary segments in three separate pieces for surgery
- Three-piece Le Fort I osteotomy with posterior impaction and expansion, bilateral inverted L-osteotomies with bone grafting and advancement genioplasty
- Postsurgical orthodontic treatment to be continued with level and aligning of both maxillary and mandibular dentition as a single unit. In addition, care detailing of the dentition was performed
- Retention.

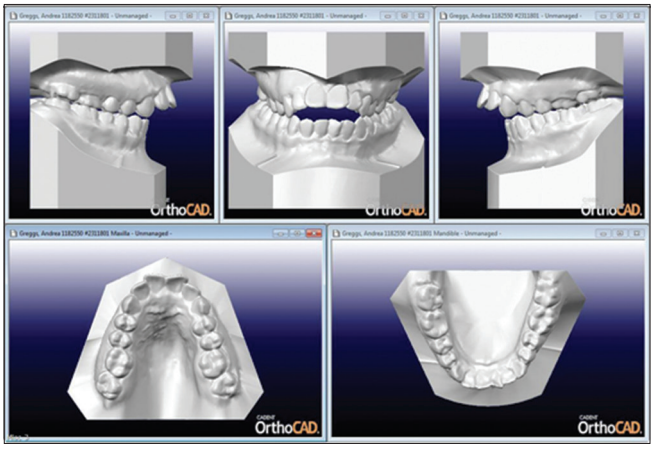

Figure 2: Pretreatment study models

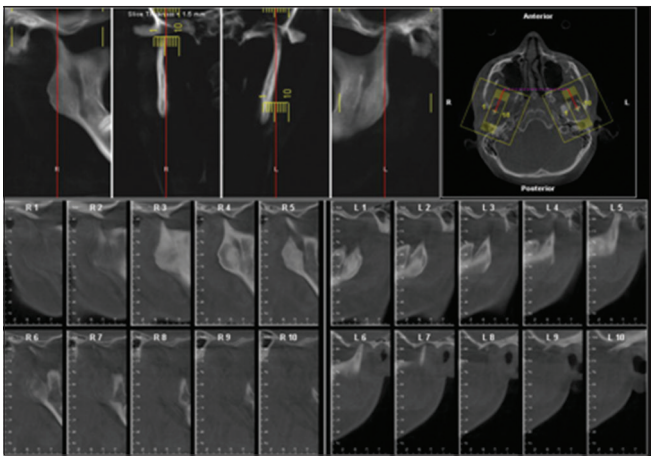

Figure 4: Pretreatment tomograms

Presurgical orthodontic treatment

Orthodontic treatment was initiated with ceramic 022 MBT prescription brackets (Radiance, American Orthodontics, WI, USA). A segmented alignment was carried out in three sections with bends to distalize canine roots and mesialize lateral incisor roots. The final working wires were 19 × 25 SS wires and with surgical hooks placed just before the orthognathic procedure. A "snap" impression was taken to insure alignment, and the patient was referred to the maxillofacial surgery department [Figure 6].

Surgical procedures

Under general anesthesia, the maxilla was skeletally expanded through 3-piece Le Fort I osteotomy with further posterior impaction by which molars were intruded and intermolar width was increased. The condyles were seated as best (due to the severe resorption) and the mandible surgically advanced with inverted L-osteotomy to lengthen the ramus via extraoral approach. These gaps were filled with the autografts from the iliac crest. The mandible was auto-rotated and bite closed. A genioplasty was also performed. Mandibular intercanine and intermolar widths were maintained. Mobilized sections were secured with screws and plates, and intermaxillary splint was placed in site. A list of occlusal and anteromedial landmarks from preoperative position to simulated postoperative position was computed by medical modeling and could be found in Table 2 [Figure 7].

Postsurgical orthodontic treatment

Treatment was followed by postoperative orthodontic treatment with continuous archwire initiated 5 weeks after surgery and settling was completed through Class II box elastic. Essix retainer was advised for retention. The total treatment lasted 18 months [Figures 8 and 9].

Table 1: Cephalometric summary

Measurements	Pre-TX A	Prog A1	Post-TX B	Difference |A−B|
SNA°	79.7	80.9	78.9	0.8
SNB°	73.7	74.5	75.7	2
ANB°	6	6.5	3.2	2.8
SN-MP°	53.3	51.3	49.4	3.9
FMA°	41.9	41.3	38.2	3.7
U1-NA (mm)	9.3	8.7	7.3	2
U1-SN°	110.4	103.3	102.7	7.7
L1-NB (mm)	6.9	8.7	8.1	1.2
L1-MP°	88.5	96.8	89.9	1.4
UL to E plane (mm)	−0.5	1.5	−5.2	4.7
LL to E plane (mm)	2.2	4.2	−3.1	5.3

Treatment results

Dental analysis revealed that maxilla dental A-P dimension was significantly improved. Vertical dimension was significantly improved. In the transverse dimension, maxillary dentition showed expansion as planned by combination of surgery and orthodontic treatments, yet transverse dimension was maintained in the mandible. Skeletal analysis showed that maxilla was maintained in its previous A-P position; however, mandible was advanced and SNB increased and ANB decreased. In the vertical plane, maxilla has undergone a remarkable change, mandibular posterior ramus length was increased and FMA was decreased as planned (FMA: 38.2) [Figures 10-12].

The 1-year postsurgery follow-up revealed improved esthetics, significant anterior–posterior changes in mandible with reduced lower third height, increased ramus length. Major treatment goals were maintained stable which are outlined in Table 1. Though overjet was acceptable, the patient may have benefited more from maxillary incisors buccal root torque and some interproximal enamel reduction. TMJ symptoms were much improved and the patient was satisfied with the result. Final esthetic and functional outcomes were highly desirable by both orthodontist and maxillofacial surgeon [Figure 13].

DISCUSSION

A case of ICR is described who suffered from skeletal Class II malocclusion and open bite with severe convex profile. The patient underwent orthodontic and orthognathic surgery treatments to establish desirable function and esthetics in terms of Class I occlusion, corrected cant, increased maxillary width, anterior positioning of mandible, better lateral soft-tissue profile, improved TMJ pain in addition to patient satisfaction, and higher self-confidence about her appearance.

Due to maxillary transverse hypoplasia, gummy smile, severe convex profile (ANB = 6°), open bite, and asymmetries, the incorporation of surgery into final treatment plan was inevitable.

As evident in postoperative radiographs and clinical photographs, remarkable achievement was made to correct patient problems

Table 2: Movement summary

Point	Name	Anterior/posterior	Left/right	Up/down
ANS	Anterior nasal spine	0.27 mm posterior	1.91 mm left	0.05 mm down
A	A point	0.22 mm posterior	1.72 mm left	0.09 mm down
ISU1	Midline of upper incisor	0.00 mm	1.50 mm left	0.00
U3L	Upper left canine	0.68 mm anterior	3.92 mm left	2.19 mm up
U6L	Upper left anterior molar (mesiobuccal cusp)	0.16 mm anterior	3.47 mm left	0.88 mm up
U3R	Upper right canine	2.12 mm anterior	0.68 mm right	2.77 mm up
U6R	Upper right anterior molar (mesiobuccal cusp)	1.41 mm anterior	0.76 mm right	0.82 mm down
ISL1	Midline of lower incisor	6.49 mm anterior	2.20 mm left	7.13 mm up
L6L	Lower left anterior molar (mesiobuccal cusp)	4.76 mm anterior	1.94 mm left	0.36 mm up
L6R	Lower right anterior molar (mesiobuccal cusp)	5.07 mm anterior	1.95 mm left	0.36 mm down
B	B point	11.21 mm anterior	2.51 mm left	4.58 mm up
Pog	Pogonion	18.61 mm anterior	2.83 mm left	3.74 mm up

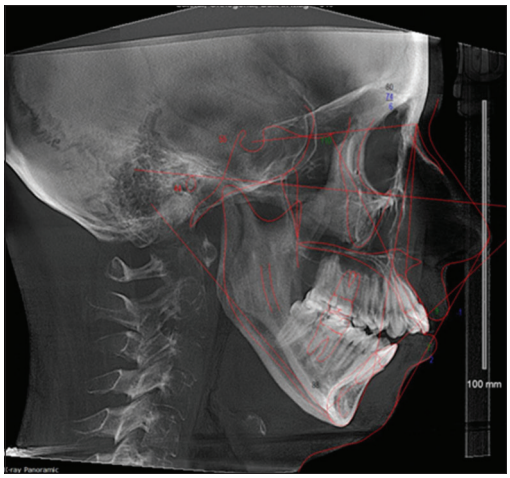

Figure 5: Pretreatment cephalometric tracing

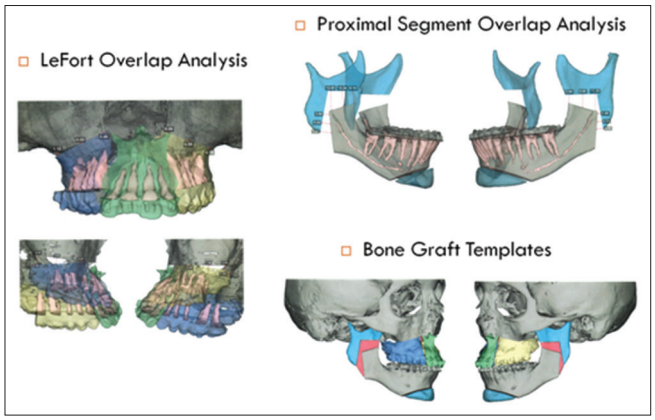

Figure 7: Virtual surgical planning

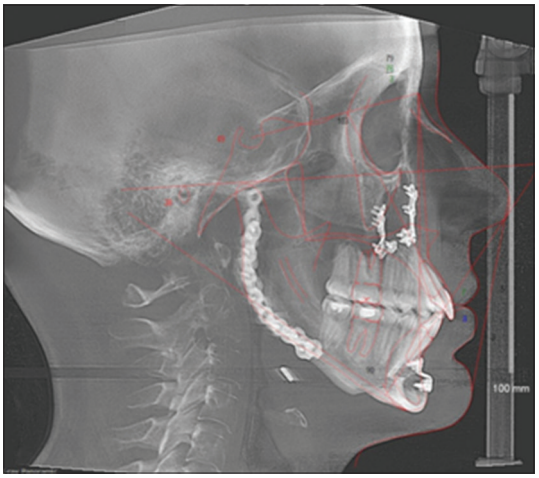

Figure 9: Postsurgical radiograph

both apparently and numerically (e.g., increased maxillary molar width, decreased mandibular plane angle in relation to SN, and Frankfort reference lines). Mandibular dentition was almost kept unchanged.

A 3-piece maxillary Le Fort I was decided as the maxilla was hypoplastic in the transverse dimension. The maxilla was also

Figure 6: Presurgical photographs

Figure 8: Postsurgical photographs

Figure 10: Superimposition cephalometrics before and after treatment

excessive in the posterior vertical dimension and was surgically impacted to obtain a satisfactory result.

Figure 11: Posttreatment photographs

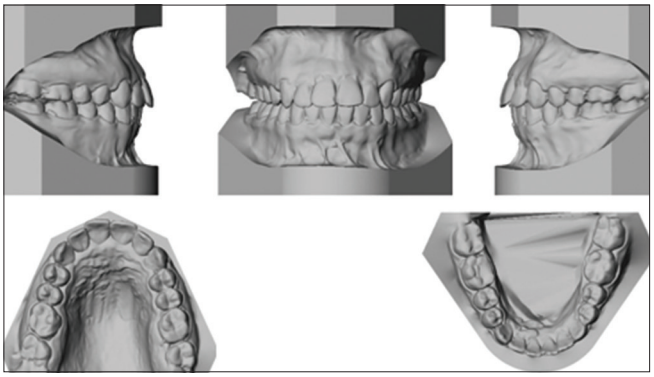

Figure 12: Posttreatment study models

Figure 13: Postretention photographs

The question on whether the condylar resorption was unilateral or bilateral was first identified by patient history followed by chair-side clinical examination. In addition, further diagnosis was verified by bone scan or computerized tomography and magnetic resonance imaging which present activity of disease and corresponding tissue pathologic changes, respectively. Bilateral cases are easier to be diagnosed because the mandible rotates posteriorly and often presents with a skeletal Class II malocclusion with or without anterior open bite. Unilateral cases usually demonstrate midline and chin shift to the affected site with ipsilateral Class II malocclusion and open bite on the nonaffected side. The activity of disease could be identified based on patient self-report and serial examination affirmed with bone isotope scans.[3]

Generally, a variety of treatment options for ICR cases may include single splint therapy, occlusal splint before and after surgery, condylar replacement with either costochondral graft or total replacement of TMJ with alloplastic prosthesis, single maxillary surgery to correct occlusal deformity, gradual advancement of mandible with distraction osteogenesis (DO), open joint surgery with disk repositioning and stabilization by Mitek mini anchor device, TMJ surgery to remove hyperplastic synovial with disk repositioning followed by orthognathic surgery.[4] In some cases, intrusion of maxillary molars with miniscrews or miniplates and mandibular surgery may allow a clinician to avoid extensive maxillary surgeries. Among various possible single or combined treatment options, mandibular surgery with inverted ramus L-osteotomy (IRLO) was opted to correct skeletal problems and to increase ramus length. Introduction of the inverted L-osteotomy technique dates back to 1957 and this technique was integrated with sagittal split ramus osteotomy (SSRO). However, neurosensory disturbance and technical difficulties are some drawbacks of such techniques. It could be performed both intraorally and extraorally, yet a facial scar may be inevitable. Dattilo *et al*. reported lower relapse of IRLO in Class II and Class III open bite than SSRO method. IRLO may be a better option when more than 12 mm of mandibular advancement is required. Moreover, lower incidence of lip hypoesthesia is reported by other scholars. In this report, our patient did not develop any sensorineural defects. This is probably related to the extraoral approach sparing infra-alveolar nerve through medial ramus dissection. As suggested by other surgeons, the intraoral approach is also advocated though a precise description of fixation of graft between segments is lacking. We believe that extraoral approach is safer to position the harvested segments and to fix the graft bone.[5]

Each strategy should be carefully selected after thorough examination, risk assessment, status of disease activity (i.e., in active or remission phase), extent of current esthetic and functional problems, TMJ anatomy (e.g., inclination of condylar neck and remaining salvageable disk), time of diagnosis, and patient' desire. As mentioned before, the complex maxillary problems and severe mandibular deficiency lead to a combined fixed orthodontic and surgery decision. Among many surgery options, the use of costochondral graft is avoided because it requires a rib transplant with subsequent morbidity. However, total alloplastic replacement obviates such morbidity and offers the advantage of functional joint soon after surgery, but some of these may need to be replaced after a while. Gradual DO of mandible possesses the physiologic benefit by which slow soft tissue and musculature adaptation is allowed.[4]

Single splint therapy was not ideal in our case because of the severity of the skeletal problem and the presence of open bite. The rationale was that the splint therapy could aggravate posterior open bite. Our patient did benefit from an occlusal splint for 5 weeks after the surgery. The principle of long-term (i.e., before and after surgery) occlusal splint therapy in adjunct to

pharmacologic anti-inflammatory and muscle relaxant agents as proposed by Guston and Arnett, is to reduce the chance of bone resorption after surgery.

Our surgical management was facilitated by 3D modeling. This recent technique gives the clinician a better and more realistic patent of soft and hard tissue changes after various desired surgical plans. In comparison to manual model surgery (MMO) and virtual model surgery (VMO), the latter method obtained a higher accuracy score. This superiority includes additional benefits with more profound investigation of buccal corridors, curves of Choi *et al*.[6]

CONCLUSION

This case report illustrated the treatment process of skeletal Class II deficiency and open bite associated with ICR in a young female patient. A 3D simulation of surgical process and orthodontic treatment were applied in combination to resolve esthetic, functional concerns and patients discomfort.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Nanda R. Esthetics and Biomechanics in Orthodontics. 2nd ed. St. Louis: Elsevier Saunders; 2015. p. 147-8.
2. Farrell BB, Franco PB, Tucker MR. Virtual surgical planning in orthognathic surgery. Oral Maxillofac Surg Clin North Am 2014;26:459-73.
3. Wolford LM, Cardenas L. Idiopathic condylar resorption: Diagnosis, treatment protocol, and outcomes. Am J Orthod Dentofacial Orthop 1999;116:667-77.
4. Mercuri LG. Alloplastic total joint replacement: A management option in temporomandibular joint condylar resorption. Semin Orthod 2013;19:116-26.
5. Dattilo DJ, Braun TW, Sotereanos GC. The inverted L osteotomy for treatment of skeletal open-bite deformities. J Oral Maxillofac Surg. 1985;43:440-3.
6. Choi JY, Song KG, Baek SH. Virtual model surgery and wafer fabrication for orthognathic surgery. Int J Oral Maxillofac Surg. 2009;38:1306-10.